FORMATION OF OHMIC CONTACTS IN III-NITRIDE LIGHT EMITTING DEVICES

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a divisional of Application Serial No. 09/755,935, filed January 5, 2001, now Patent No. 6,657,300 which is a continuation-in-part of Application Serial No. 09/092,065, filed June 5, 1998, now abandoned. Application Serial Nos. 09/755,935 and 09/092,065 are incorporated herein by reference.

BACKGROUND

FIELD OF INVENTION

[0002] The present invention is related to the manufacture of III-V light emitting and laser diodes, particularly towards improving the characteristics of the electrical contact to the p-type portion of the diode.

DESCRIPTION OF RELATED ART

[0003] Gallium nitride (GaN) compounds have wavelength emissions in the entire visible spectrum as well as part of the UV. Figure 1 illustrates a typical GaN-based light emitting diode (LED). Currently, most GaN-based LEDs are epitaxially grown on a sapphire or silicon carbide (SiC) substrate. A double hetero-structure that includes a nucleation layer, n-type layer, active region, p-type AlGaN layer, and a p-type layer of GaN is formed on the substrate. In general, the ability to fabricate ohmic contacts to the p-type layer is essential for the realization of reliable light emitting diodes and laser diodes. Ohmic contacts to p-type GaN are difficult to achieve because the attainable hole concentration is limited for Mg-doped III-nitride based semiconductors. In addition, many light-emitting diodes and vertical cavity surface-emitting laser diodes use thin, transparent metal contacts. The choice of metals is limited and metal layers need to be thin, e.g. < 15 nm, to reduce light absorption. Because there is poor lateral current spreading in p-type GaN, the metal layers typically cover nearly the entire device area.

[0004] P-type conductivity for GaN is achieved by doping with Mg, which substitutes for gallium in the GaN lattice and acts as an acceptor (Mg_{Ga}). Mg_{Ga} introduces a relatively deep